REPAIR OF CORRODED STEEL BRIDGE COLUMNS USING ULTRA-HIGH PERFORMANCE CONCRETE: EXPERIMENTAL STUDY

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Abstract

Most of the existing steel bridges in the United States have been experiencing moderate to severe corrosion of steel H-pile columns, resulting in the reduction of the overall bridge load-carrying capacity and are in dire need for the repair. This project focuses on the use of ultra-high performance concrete (UHPC) in the composite repair system for the corroded steel H-pile bridge columns. The composite repair system includes different UHPC configurations with/without an embedded carbon fiber-reinforced polymer (CFRP) grids and that bolted on the steel H-pile by shear connectors (SC). Twelve full-scale steel H-pile columns were repaired with the proposed composite system and investigated under push-out test and the load-carrying capacity of the tested columns has been evaluated. The experimental results revealed that the proposed repair system using UHPC panels was easy to implement in real-world applications. Using UHPC panels with the embedded CFRP grids and bolted on the inner and outer flanges of the steel H-pile improved significantly the load-carrying capacity of the investigated columns.

Background

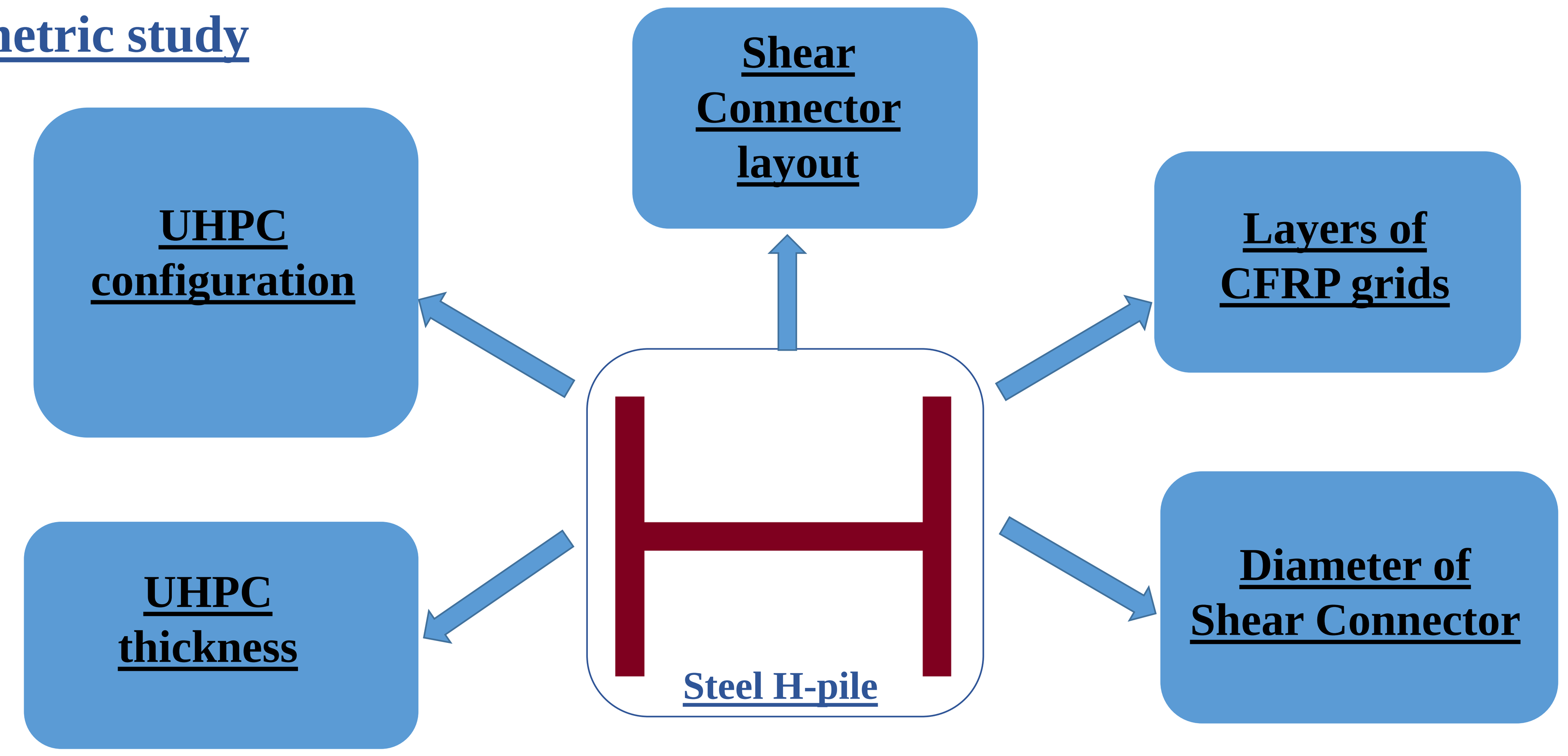
- In 2016, 56,007 (9.1%) of nation's bridges were **STRUCTURALLY DEFICIENT**.
- ASCE bridge report card– **C+**
- **Missouri** has the **4th highest** number of deficient bridges in the US with more than **3,195 deficient bridges**.
- 15% of structurally deficient bridges experience heavy corrosion damage

Objective

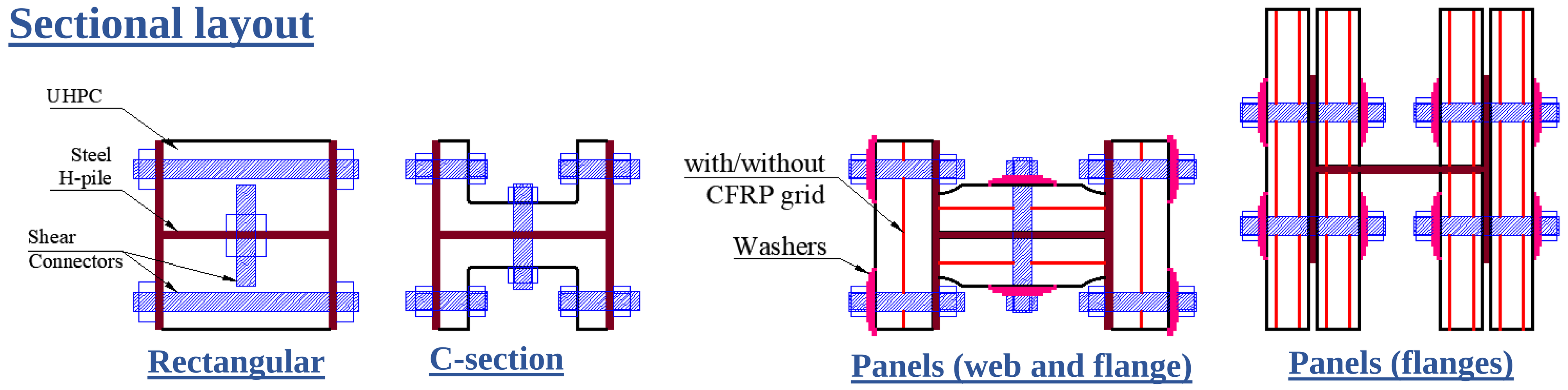
- Investigate the **use and applicability** of **ultra-high performance concrete (UHPC)** in the composite repair system for the corroded steel H-pile bridge columns.
- Recommend an ideal repair method for the corroded steel H-pile bridge columns capable of **restoring the original axial capacity.**

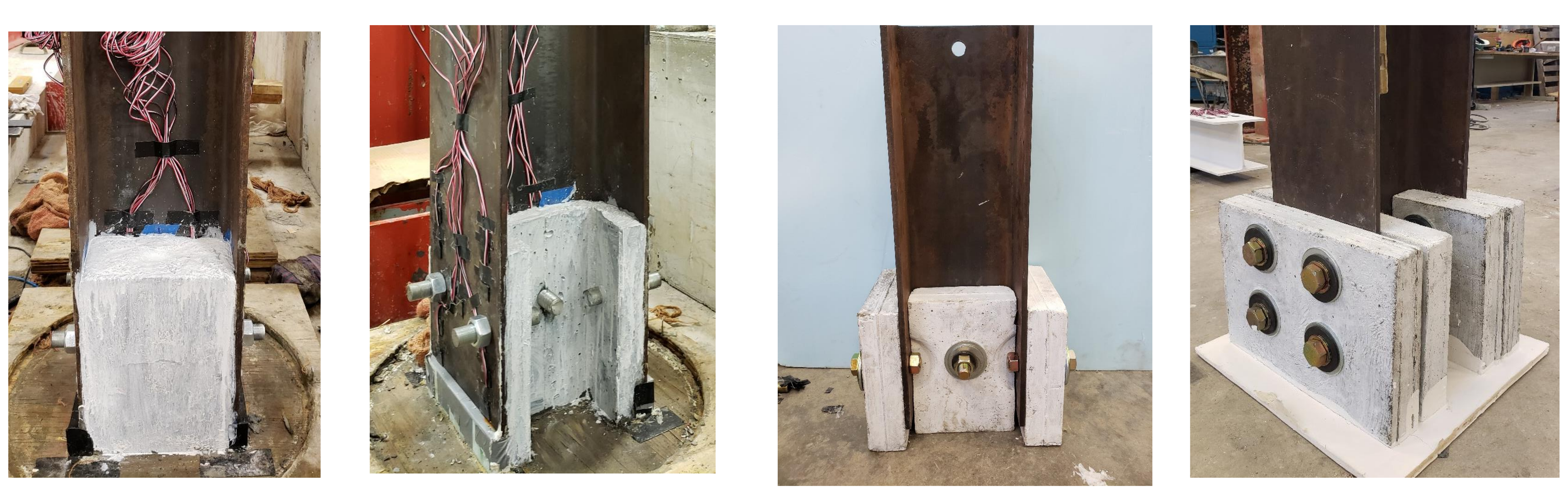
Experimental study

Parametric study

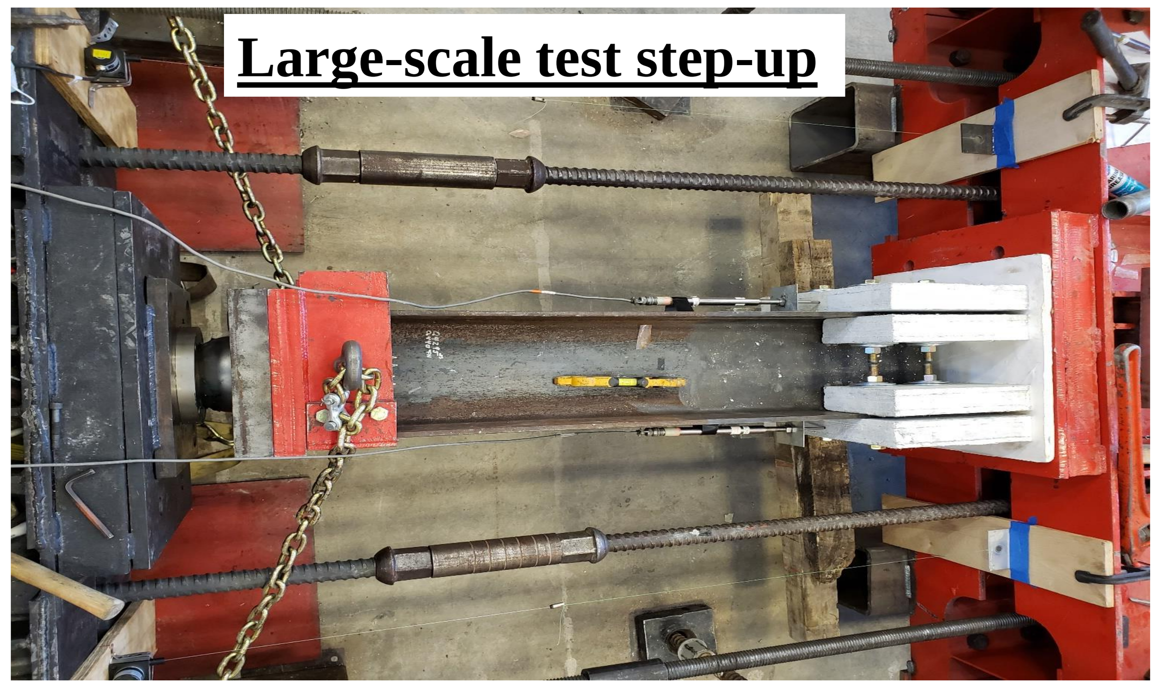


Sectional layout





CFRP grid

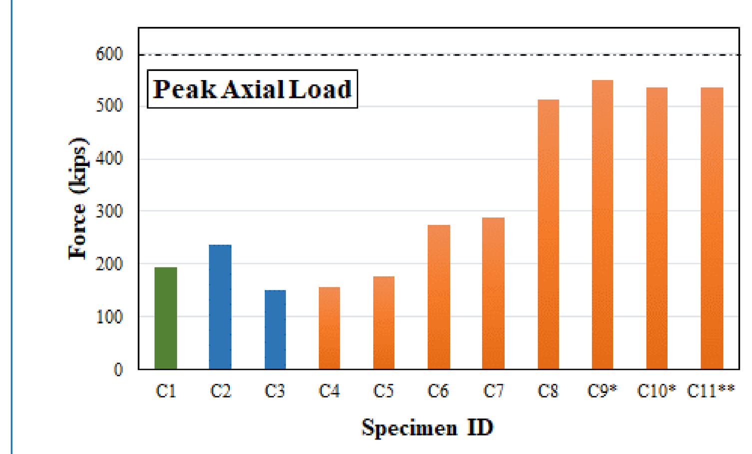


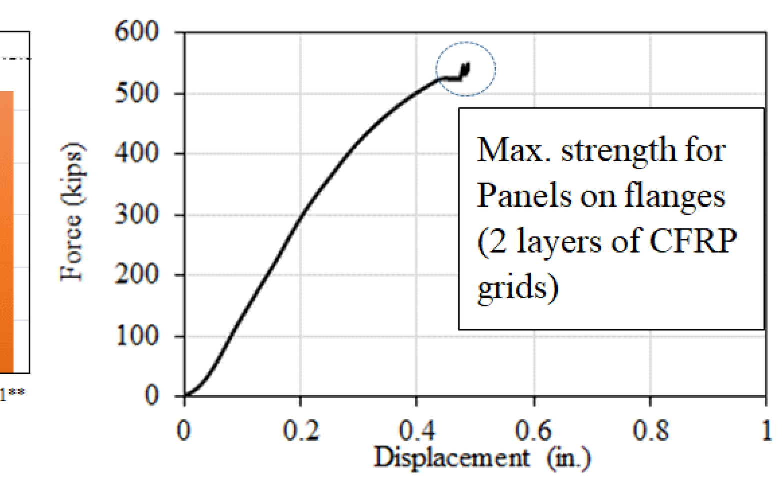
Push-out Test

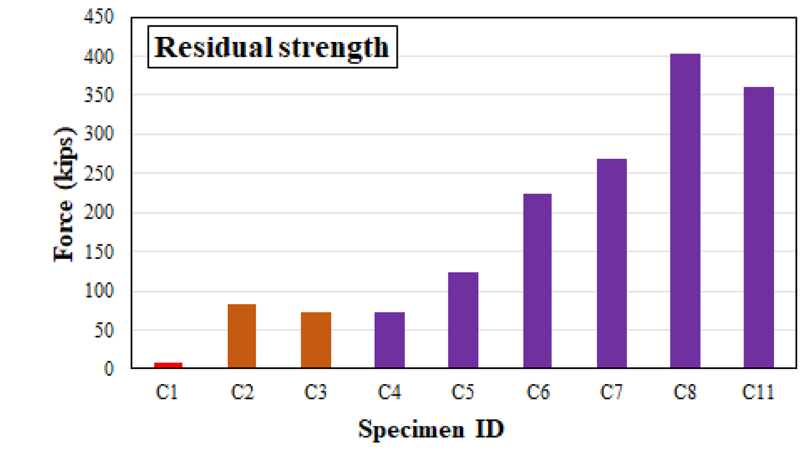
Test Results

Mode of failure

Axial load vs displacement response and Residual Strength







Conclusion

- Increasing UHPC panel thickness, diameter of SC or adding CFRP-grid layers as reinforcement in UHPC increased the axial load capacity.

- The highest axial load capacity and residual strength was obtained with UHPC reinforced with CFRP grids encased on both sides of flange of the steel H-pile mounted by shear connectors.

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